

CLAIMS

1. A diffractive optical processor having a substrate, and an axis normal to at least a portion of a surface of the substrate comprising:
- 5        a first mirror surface suspended over the substrate, at least a portion of the first mirror surface normal to the axis, the first mirror surface having two ends and displaceable in the direction of the axis;
- at least one support coupled to the first mirror surface at a point intermediate the ends of the first mirror surface; and
- 10      a second mirror surface, at least a portion of the second mirror surface normal to the axis, the second mirror surface optically adjacent to first mirror surface, the second mirror surface separated from the first mirror surface a distance in the direction of the axis.
2. The diffractive optical processor of claim 1, further comprising an actuation beam suspended over the substrate to form an actuation gap, the actuation beam coupled to the at least one support to suspend the first mirror surface over the substrate, the actuation beam including an actuation region displaceable through the actuation gap, wherein when the actuation beam is actuated, the actuation region is displaced through the actuation gap, the first mirror element is displaced in the direction of the axis, and the distance is changed.
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- 20      The diffractive optical processor of claim 1, further comprising a frame coupled to the ends of the first mirror surface, wherein the ends of the first mirror surface are maintained a fixed distance above the substrate, and further wherein when the first mirror surface is displaced in the direction of the axis such that the distance is changed, the first surface exhibits a curvature which is caused to be altered by the at least one support.
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3. The diffractive optical processor of claim 1, further comprising a frame coupled to the ends of the first mirror surface, wherein the ends of the first mirror surface are maintained a fixed distance above the substrate, and further wherein when the first mirror surface is displaced in the direction of the axis such that the distance is changed, the first surface exhibits a curvature which is caused to be altered by the at least one support.
4. The diffractive optical processor of claim 3, wherein a portion of the first mirror is caused to be substantially planar by the at least one support.
- 30      5. The diffractive optical processor of claim 2, further comprising a mirror beam having a top surface, the mirror beam suspending the second mirror surface above the substrate and forming a beam gap.

6. The diffractive optical processor of claim 5, wherein the second mirror surface covers the width of the top surface of the mirror beam from edge to edge.

7. The diffractive optical processor of claim 5, wherein the mirror beam suspends the  
5 second mirror surface a fixed distance above the substrate.

8. The diffractive optical processor of claim 5, wherein the mirror beam is actuatable.

9. The diffractive optical processor of claim 1, wherein the width of the first mirror  
10 surface is equal to the width of the second mirror surface.

10. The diffractive optical processor of claim 1, wherein the width of the second mirror surface is larger than the width of the first mirror surface.

15 11. A diffractive optical processor having a substrate, and an axis normal to at least a portion of a surface of the substrate comprising:

a plurality of first mirror surfaces, each having two ends, at least a portion of each of the plurality first mirror surfaces normal to the axis, and each suspended over the substrate and displaceable in the direction of the axis;

20 a plurality of supports each coupled to a corresponding one of the plurality of first mirror surfaces at a point intermediate the ends of the corresponding one of the plurality of first mirror surfaces; and

25 a plurality of second mirror surfaces, at least a portion of each of the plurality of second mirror surfaces normal to the axis, each of the second mirror surfaces optically adjacent to at least a corresponding one of the plurality first mirror surfaces, each of the plurality of second mirror surfaces separated from the corresponding one of the plurality of first mirror surface a corresponding distance in the direction of the axis.

30 12. The diffractive optical processor of claim 11, further comprising a plurality of actuation beams suspended over the substrate, each forming a corresponding actuation gap, the plurality of actuation beams each coupled to at least one of the plurality of supports to suspend a corresponding one of the plurality of first mirror surfaces over the substrate, each

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of the plurality of actuation beams including a corresponding actuation region displaceable through a corresponding actuation gap, wherein when one of the plurality of actuation beams is actuated, the corresponding actuation region is displaced through the corresponding actuation gap, a corresponding first mirror element is displaced in the direction of the axis,  
5 and a corresponding distance is changed.

13. The diffractive optical processor of claim 11, further comprising a frame coupled to the ends of each of the plurality of first mirror surfaces, wherein the ends of each of the plurality of first mirror surfaces are maintained a fixed distance above the substrate, and  
10 further wherein when one of the plurality of first mirror surfaces is displaced in the direction of the axis such that the distance is changed, the one of the plurality of first mirror surfaces exhibits a curvature which is caused to be altered by a corresponding at least one of the plurality of supports.

15. 14. The diffractive optical processor of claim 13, wherein a portion of the one of the plurality of first mirror surfaces is caused to be substantially planar by at least one of the plurality of supports.

15. The diffractive optical processor of claim 11, further comprising a plurality of mirror beams each having a top surface, each of the plurality of mirror beams suspending a corresponding one of the plurality of second mirror surfaces above the substrate and each forming a corresponding beam gap.  
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16. The diffractive optical processor of claim 15, wherein each of the plurality of second mirror surfaces covers the width of the top surface of a corresponding one of the plurality of mirror beams from edge to edge.  
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17. The diffractive optical processor of claim 15, wherein each of the plurality of mirror beams maintains a corresponding one of the second mirror surfaces a fixed distance above the substrate.  
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18. The diffractive optical processor of claim 15, wherein at least one of the plurality of actuation beams is coupled to two neighboring mirror beams of the plurality mirror beams, and wherein the at least one actuation beam is suspended above the substrate by the two neighboring mirror beams.
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19. The diffractive optical processor of claim 11, wherein the widths of each of the plurality of first mirror surfaces is equal to widths of each of the plurality of second mirror surfaces.
- 10 20. The diffractive optical processor of claim 11, wherein the widths of each of the plurality of second mirror surfaces is larger than the widths of each of the plurality of first mirror surfaces.
- 15 21. The diffractive optical processor of claim 11, further comprising a controller electrically coupled to the diffractive optical processor for controlling the displacement of the plurality of first mirror surfaces.
- 20 22. An electrostatically-actuated diffractive optical processor having a substrate, and an axis normal to at least a portion of a surface of the substrate comprising:  
a plurality of first mirror surfaces, each having two ends, at least a portion of each of the plurality of first mirror surfaces normal to the axis, and each suspended over the substrate and displaceable in the direction of the axis;
- 25 a plurality of supports each coupled to at least a corresponding one of the plurality of first mirror surfaces at a point intermediate the ends of the corresponding one of the plurality of first mirror surfaces;  
a plurality of actuation beams, each of the plurality of actuation beams suspended over the substrate to form a corresponding actuation gap, each of the plurality of actuation beams coupled to at least one of the plurality of supports to suspend a corresponding one of the plurality of first mirror surfaces over the substrate, each of the plurality of actuation beams including an actuation region displaceable through the corresponding actuation gap;
- 30 a plurality of second mirror surfaces, at least a portion of each of the plurality of second mirror surfaces normal to the axis, each of the plurality of second mirror surfaces

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optically adjacent to at least a corresponding one of the plurality of first mirror surfaces, each of the plurality of second mirror surfaces separated from the corresponding one of the plurality of first mirror surfaces by a distance in the direction of the axis; and

5        a plurality of electrodes, each provided on the substrate and corresponding to one of the plurality of actuation beams;

      wherein when a voltage is applied between one of the plurality of actuation beams and the corresponding one of the plurality of electrodes, the actuation region is displaced through the corresponding actuation gap, the corresponding first mirror element is displaced, and the distance is changed.

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23.      The diffractive optical processor of claim 22, wherein each of the plurality of first mirror surfaces is coupled at the ends, and further wherein when one of the plurality of first mirror surfaces is displaced in the direction of the axis such that the distance is changed, the one of the plurality of first mirror surfaces exhibits a curvature which is caused to be altered by a corresponding at least one of the plurality of supports.

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24.      The diffractive optical processor of claim 22, wherein the curvature of the one of the plurality of first mirror surfaces is caused to be substantially planar by the corresponding at least one of the plurality of supports.

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25.      The diffractive optical processor of claim 22, further comprising a plurality of mirror beams each having a top surface, each of the plurality of mirror beams suspending a corresponding one of the plurality of second mirror surfaces above the substrate and each forming a corresponding beam gap.

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26.      The diffractive optical processor of claim 25, wherein each of the plurality of second mirror surfaces covers the width of the top surface of a corresponding one of the plurality of mirror beams from edge to edge.

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27.      The diffractive optical processor of claim 26, wherein each of the plurality of mirror beams suspends a corresponding one of the second mirror surfaces a fixed distance above the substrate.

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28. The diffractive optical processor of claim 25, wherein at least one of the plurality of actuation beams is coupled to two neighboring mirror beams of the plurality mirror beams, and wherein the at least one actuation beam is suspended above the substrate by the two

5 neighboring mirror beams.

29. The diffractive optical processor of claim 22, wherein the widths of each of the plurality of first mirror surfaces is equal to widths of each of the plurality of second mirror surfaces.

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30. The diffractive optical processor of claim 22, wherein the widths of each of the plurality of second mirror surfaces is larger than the widths of each of the plurality of first mirror surfaces.

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31. The diffractive optical processor of claim 22, further comprising a controller electrically coupled to the diffractive optical processor for controlling the displacement of the plurality of first mirror surfaces.

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32. The diffractive optical processor of claim 22, further comprising processing circuitry integrated on the substrate and coupled to the plurality of electrodes, to control the displacement of the plurality of first mirror surfaces.

33. A telecommunications system, for transmitting a wavelength division multiplexed signal, comprising:

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a demultiplexer for separating the wavelength division multiplexed signal into a plurality of sub-signals; and

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a diffractive optical processor optically coupled to the demultiplexer for receiving and diffracting at least one of the plurality of sub-signals, the diffractive optical processor having a substrate and an axis normal to at least a portion of a surface of the substrate, a plurality of first mirror surfaces each having two ends and a portion of each of the plurality of first mirror surfaces normal to the axis and suspended over the substrate, and each of the plurality of first mirror surfaces displaceable in the direction of the axis, a plurality of supports each coupled

to a corresponding one of the plurality of first mirror surfaces at a point intermediate the ends of the corresponding one of the plurality of first mirror surfaces, and a plurality of second mirror surfaces, a portion of each of the plurality of second mirror surfaces normal to the axis, each of the second mirror surfaces optically adjacent to at least a corresponding one of the plurality of first mirror surfaces, each of the plurality of second mirror surfaces separated from the corresponding one of the plurality of first mirror surfaces a distance in the direction of the axis.

34. The telecommunication system of claim 33, further comprising a multiplexer optically coupled to the diffractive optical processor for multiplexing two or more of the plurality of sub-signals.

35. The telecommunication system of claim 33, further comprising a controller electrically coupled to the diffractive optical processor for controlling the diffraction of at least one of the sub-signals.

36. The telecommunication system of claim 33, wherein the diffractive optical processor has a top surface, and wherein at least one of the sub-signals impinges on the diffractive optical processor substantially normal to the top surface.

37. The telecommunications system of claim 33, wherein the demultiplexer is a diffractive demultiplexer.

38. The telecommunication system of claim 33, wherein the system is configured to operate as a gain equalization filter.

39. The telecommunication system of claim 33, wherein the system is configured to operate as a variable optical attenuator.

40. The telecommunication system of claim 33, wherein the system is configured to operate to add a sub-signal to the main pathway.

41. The telecommunication system of claim 33, wherein the system is configured to operate to drop a sub-signal from the main pathway.